coveries." This motion, after some discussion, was carried unanimously.

Dr. Schröder (Hamburg) then finished the communication begun at the previous meeting. Herren Abbe (Jena), Saffarik (Prague), Bruhns (Leipzig), Winnecke (Strassburg), took part in the discussion on it. Prof. Oudemans (Utrecht) reported on the Gaussian object-glass of the Utrecht Observatory. Dr. Huggins (London) gave an account of his results in photographing star-spectra, and showed some of them to the meeting. Prof. Bruhns (Leipzig) exhibited drawings of nebula and neighbouring stars made by students of the University with small telescopes. Prof. Abbe (Jena) gave an elaborate account of his important theoretical and experimental researches in optics, followed by a discussion between him and Herren Förster and Winnecke. Prof. van de Sande Bakhuyzen (Leyden) explained his researches upon the dependance of the personal error in transit observations from the magnitude of the stars. Prof. Schönfeld (Bonn) reported on the progress of his "Durchmusterung" of the southern heavens. There is finished in observation at present about two-thirds of the whole work.

After a vote of thanks to the Prussian Government, the Royal Academy of Sciences, and the Berlin astronomers, the meeting of the International Astronomical Society was closed late in the afternoon. A. WINNECKE

INFLUENCE OF ELECTRICITY ON VEGETATION

SEVERAL months ago, it will be remembered, M. Grandeau described to the Paris Academy experiments made by himself and M. Leclerc at Nancy and Mettray, whence it appeared that flowering and fructification are retarded and impoverished if plants are excluded from the influence of atmospheric electricity—as by being inclosed in a metallic cage, or being near trees or other objects which may carry off electricity of the air.

Recently M. Naudin has repeated the experiments referred to, but with other plants and in a different climate, and, without wishing to contradict the conclusions arrived at for tobacco and maize (the plants that had been experimented with), he is led to regard the declarations made as too general, inasmuch as his results are almost exactly opposite to those obtained by MM. Grandeau and Leclerc.

It was at Antibes, in the large botanical garden formed by the late Thuret (now Government property), that M. Naudin made his experiments. He had an iron quadrangular cage made, covering a surface of fifty-one square decimetres, and about one metre in height; the frame carried points above (like small lightning conductors), and was covered with iron netting, the lozenge-meshes of this being 0·09m. long by 0·054 m. broad (it intercepted more light than M. Grandeau's, but this is thought insignificant). The cage was placed in a kitchen garden, and the plants it was made to inclose were kidney beans, lettuce, tomato, and herbaceous cotton (the last alone being sown as seed). In the same garden, at 7 metres distance, plants as like the others as possible were planted, and cotton seeds of the same kind sown, but without a cage-cover. The soil was perfectly homogeneous throughout, and all parts of the plot were equally exposed to sunlight, dew, and rain. The experiment began on May 25.

For a fortnight there appeared no sensible difference between the two portions; but about the middle of June it was remarked that the plants of the cage were stronger than those in the open air, and this difference became more pronounced as time went on. The plants, indeed, progressed side by side in this sense, that the flowerings were absolutely contemporaneous in the plants of the same species; and it was the same with formation and maturation of fruits. But it was quite otherwise with the quantity of vegetable matter produced in a given time and on the same extent of soil, and this difference was entirely in favour of the caged plants.

We may take the figures tabulated by M. Naudin for the tomato (examined August 14), as a good example of this:—

	Tomato in open air.	Tomato under the cage.
Length of the principal stem ...	0·80 m.	... 1·0 m.
Total weight of the plant cut at the level of the ground, fruits included	2·072 kg.	... 3·754 kg.
Number of ripe fruits and green fruits of all sizes ...	37	... 83
Weight of the whole of the fruit detached from the plant	1·80 kg.	... 2·162 kg.

The other plants gave a similar testimony in favour of the withdrawal of atmospheric electricity. Thus, the total weights of the bean plants were respectively 142 gr. and 167 gr.; and of the lettuce 337 gr. and 427 gr. The cotton plants were weakly (as there had been no watering), but their evidence was in the same line as that of the others.

The injurious influence, which, according to M. Grandeau's theory, trees exert on plants in their neighbourhood, by withdrawing atmospheric electricity, is also considered by M. Naudin to be only a special case. Besides, it is easy to ascribe to this withdrawal what is merely the result of the shade cast by trees, and especially of the exhaustion and desiccation of the ground by their roots, which often extend to a great distance. On the other hand there are many plants which seek the neighbourhood of trees, and which even thrive only under their shadow, and these, probably, must be adapted to a diminution of atmospheric electricity. At the Villa Thuret, M. Naudin remarks, there are several lawns quite inclosed by trees (pines, firs, cypresses, &c.), many of which are adult and of pretty good size. These lawns contain, besides their grass, thousands of anemones (*A. pavonina, A. cyanea, A. stellati*), some of pure race, others hybrid, whose flowers present all shades of red, rose, purple, white, and blue. The appearance is striking when the flowers come out in March or April. The flowering is not entirely contemporaneous throughout the lawn; it begins near the trees, and gradually extends to the middle of the lawn; the difference of time between these two extremes being twelve to fifteen days. Moreover, the anemones nearest to the trees, in addition to their relative precocity, are generally stronger and taller, and have broader, perhaps more brightly coloured corollas, than those in the middle of the lawn.

From the observations described, M. Naudin is disposed to think the question as to the influence of atmospheric electricity on plants is complex, and far from being decided as yet. This influence, in all probability, is modified first by the very essence of the species, which must behave, in regard to atmospheric electricity, as to other agents of vegetation, that is to say, in very diverse manners; then it is modified by climate, season, temperature, degree of light, dry or wet weather, perhaps also by the geological structure or mineralogical composition of the ground, the layers of which, superficial or deep, may not be equally conductive of electricity. It is possible, lastly, that all tree species may not alike withdraw the electric *effluves* of the atmosphere, and this is a point necessary to be determined. Until these numerous and so obscure conditions of the problem before us are sufficiently known, we should regard as premature any conclusion which is applied to the whole, or even only to the generality of the vegetable kingdom.

THE DIFFUSION OF LIQUIDS

IT is fortunate that various branches of the work with which Graham's name will always be connected are now attracting the attention of physicists. At the

beginning of this year Prof. Osborne Reynolds gave, in a remarkable paper,[1] the results of experimental researches "On Thermal Transpiration of Gases through Porous Plates," and showed the existence of a class of very marked phenomena which had escaped the notice of other observers. More recently Dr. John H. Long has studied the diffusion of liquids, starting from the work of Graham, which must be regarded as the first and only general investigation of this subject we possess. Dr. Long's results will be briefly given in his own words, but it may be well to draw attention, as he does, to a few facts connected with the history of the subject. In two papers read before the Royal Society in 1850, Graham established that—

1. The velocity of diffusion is different for each substance in solution.

2. The amounts of salt diffused in a given time from solutions of the same substance, but different concentrations, are very nearly proportional to the concentration.

3. The amount of salt diffused from a given solution increases with the temperature.

Fick subsequently showed that liquid diffusion may be compared to the conduction of heat, that is, the spread of salt particles through water is in many respects analogous to the spread of heat in a conducting body, and that formulæ, similar to those established by Fourier for the latter case, may be applied in the former.

Certain experimentalists then employed optical methods of observation in determining the rate of diffusion of salts in solution, but Stefan showed that the optical methods "are based on a false assumption, and that they can therefore give only false results." It will be sufficient to state, however, that after a careful review of the work of the several investigators, Dr. Long divides the researches into two classes:—

1. Those which are concerned with the physical side of the question, that is, with the determination of "the constant of diffusion"[2] for a single substance. To this class belong the researches of Fick, Simmler, and Wild, Voit, Hoppe-Seyler, Johannisjanz, Weber, and Stefan.

2. Those which treat the subject from a chemical point of view, by comparing the rates of diffusion of many different substances. To this class belong the investigations of Graham, Beilstein, and Marignac. Dr. Long points out that "in regard to the first class it may be said that a very satisfactory end has been attained. The proof of Fick's law by Weber and Stefan, and the determination of the influence of temperature and concentration of solution by the former, leave little to be desired in connection with this part of the subject. The same cannot be said, however, of the other, the chemical side." The experiments of Beilstein are not sufficiently numerous to establish much with certainty, and those of Graham and Marignac, while agreeing well among themselves, do not establish the dependence of diffusion on the molecular weight or other physical property of the substance employed.

Facts such as these have led Dr. Long to undertake a lengthy series of experiments, in which he employed a method that renders it possible to determine the rate of diffusion from hour to hour, and to insure that the diffusion takes place into a medium whose concentration is always zero. His apparatus may be roughly described as consisting of a U-tube placed in a beaker, which contains the solution to be investigated. The ends of the tube are bent over the beaker, one end being connected with a funnel into which water slowly drops, displacing the solution in the U-tube, which flows out from the other end at about the rate of 40 cc. in an hour. The base of the U-tube is open, and is connected with a short vertical tube whose internal diameter is 15 mm. This larger tube is open only at the bottom, and is arranged concentrically with the beaker.

[1] *Proc.* Roy. Soc., 1879, p. 304.

[2] A dissertation presented to the Faculty of Science of the University of Tübingen, 1879.

Diffusion thus takes place between the solution *below* the line of junction of the short tube with the U-tube and the water contained in the latter, the diffused particles being carried away and discharged; in other words, there is diffusion between a level of constant concentration and a level "of concentration zero." Space will only permit us to notice the general conclusions at which Dr. Long has arrived. He observes that no simple relation is recognisable between diffusion and other physical phenomena if we merely state the results in *grammes* of substance diffused. If, on the other hand, the results are stated as the numbers of *molecules* diffused, several interesting relations appear. For instance, it can be shown that the chlorides, bromides, and iodides of the alkaline metals form a series in which NH_4 stands between K and Na; and in this series the chloride, bromide, iodide, and cyanide of potassium have nearly the same rate. The chlorides of the dyad metals Ba, Sr, Cr, and Mg are also seen to form a series as to their rates of diffusion. It can further be shown, by comparing Kohlrausch's results on the electrical conducting power of liquids with the diffusion rates, that those salts which in solution offer the least resistance to the passage of the galvanic current are the ones which diffuse most rapidly. In most cases it appears that the salts having the greatest molecular volume diffuse the best, and those salts which absorb the greatest amount of heat on passing into solution are also the ones which diffuse most rapidly.

Dr. Long shows that Graham's view that no relation exists between the molecular weight and the rate of diffusion requires modification, for the alkaline chlorides, bromides, and iodides stand in the same order as regards molecular volume, rate of diffusion, conducting power, and latent heat of solution.

In conclusion Dr. Long indicates the direction in which he proposes to continue the research, which, we may add, bears evidence of being the work of an able physicist, from whom many valuable researches may be expected.

W. CHANDLER ROBERTS

THE PARKES MUSEUM OF HYGIENE

THERE is one all important matter with which neither the great Institution in Bloomsbury nor that at South Kensington has virtually any concern; this important matter is Hygiene, the knowledge and application of the laws of life, which in so far as they are perfect banish disease from the human race. The Parkes Museum of Hygiene has been formed to promote this department of the numerous applications of science.

In the spring of 1876 the movement for the formation of the Parkes Museum commenced. It was the outcome of a very general desire to perpetuate in some useful way the memory of the late Dr. Parkes, whose life had been so unselfishly spent in promoting the welfare and happiness of his fellows by extending the knowledge of the laws of health, and whose untiring energy and keen intellect did such good service in clearing away the ignorance and superstition which accepted disease as the inevitable accompaniment of human life in this world. The movement rapidly developed into shape, and finally the Parkes Museum of Hygiene was opened to the public in June last, with a fairly representative collection of mechanical appliances, models, plans, and books, designed to promote health, of which a descriptive and illustrated catalogue was published. Since then so many valuable additions have been made to the museum that an enlarged and improved catalogue has been issued. The affairs of the museum are administered by an executive committee of which Sir William Jenner is chairman, and at present the cost of maintaining the museum has to be met wholly by voluntary contributions. The collection of appliances, models, &c., is temporarily located in the largest room of the south wing of University College, which, together